



**MITSUBISHI HITACHI POWER SYSTEMS**

**MHPS** is continuing to supply electricity safely and stably to the people in the world through engineering, procurement, manufacturing, and construction of Nuclear Turbine Plant.

**M**itsubishi Hitachi Power Systems, Ltd. (MHPS) is a new company formed integrating the power generation systems businesses of Mitsubishi Heavy Industries, Ltd. (MHI) and Hitachi, Ltd. We are challenging to resolve energy supply stability and environment compatibility simultaneously, under the corporate commitment to “contribute to society through outstanding products and technologies”. Nuclear power generation is one of the resolutions, and we have provided nuclear turbine plant with the highest reliability based on our manufacturing strength and comprehensive engineering. In this brochure, we introduce our major products of nuclear turbine plant and plant engineering capability.

**Corporate Overview**

Company Name	Mitsubishi Hitachi Power Systems, Ltd.
Establishment	February 1, 2014
Head Office	3-1 Minatomirai 3-chome, Nishi-ku, Yokohama, Kanagawa, 220-8401, Japan
Capital	100 billion yen
Employees	11,190 (Non-Consolidated) (As for April 2016)
Works in Japan	Hitachi/Yokohama/Takasago/Kure/Nagasaki
Major products and operations	GTCC Power Plants , Conventional Power Plants, IGCC Power Plants , Geothermal Power Plants, Gas Turbines, Steam Turbines, Boilers, Environmental Equipment, Generators, Control Systems

GTCC: Gas Turbine Combined Cycle  
IGCC: Integrated Gasification Combined Cycle

A welder wearing a helmet and protective suit is working on a large, circular metal component. The welder's hands are visible, holding a welding torch that is emitting a bright light. The background is dark, and the overall scene is industrial.

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# 1 Nuclear Turbine Experiences more than 40 years

## Our Mission

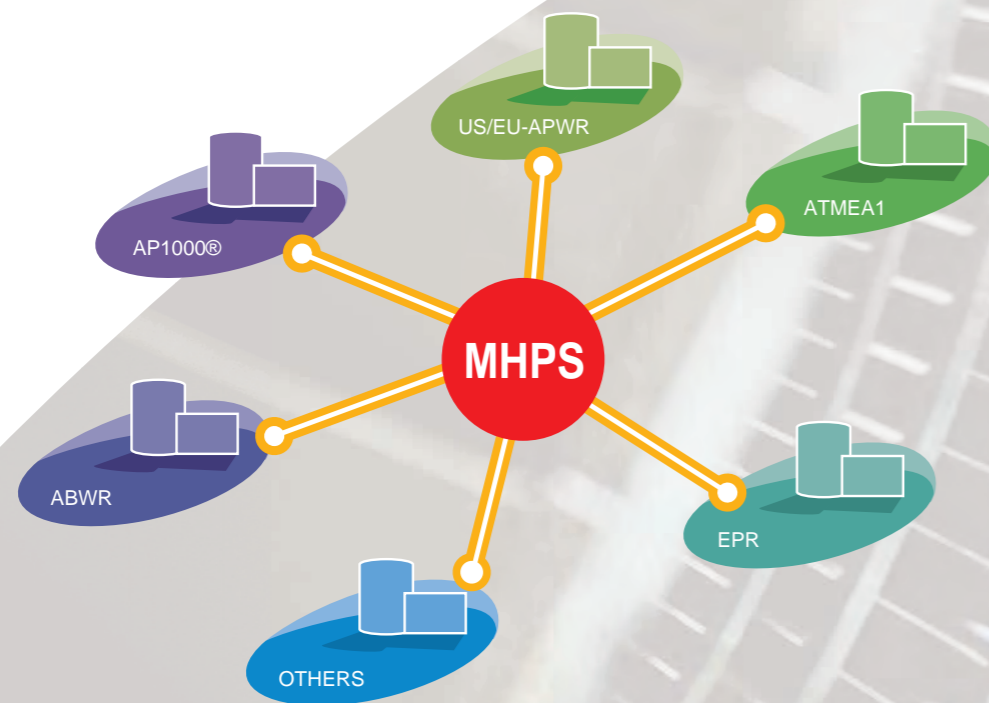
MHPS has rolled out so far for 40 years or longer nuclear turbine generators and plants featuring in high reliability and safety, based on advanced "**Manufacturing Capability**," the world's highest level of "**Technical Capability**", and "**Comprehensive Capability**" ranging from research & development to engineering, procurement, manufacturing, construction, and after-sales services.

We are determined to further provide products for nuclear power generation as well as offer best appropriate solutions for our customers, eying to maintain stable energy supply in response to worldwide rising demand as well as to give solution to worldwide challenge on earth's green by reducing carbon emission.

## We Meet Your Requirements & Conditions

MHPS is able to offer turbine generators in response to Customers' demands of reactor type, electrical output, and site conditions. MHPS also supports Customers by implementing feasibility study at the planning stage of a new project as well as by providing repair/replacement/maintenance service after the commercial operation of the plant.

■ We meet Any Requirements by Any Reactors.



(Note)  
ABWR, AP1000®, US/EU-APWR, ATMEA1 and EPR are the nuclear reactors developed by General Electric, Westinghouse, MHI, ATMEA, and Areva, respectively.

## Major Components are Manufactured In-House.

Engineering and manufacturing for nuclear turbine generators are taken charge by Takasago Works and Hitachi Works out of five production sites of MHPS.

Takasago Works design and manufacture steam turbine and large heat exchanger with total plant engineering, construction, commissioning and after-sales services mainly for PWR (Pressurized Water Reactor). Hitachi Works is in charge of design, manufacturing, construction, commissioning and after-sales service of steam turbine, generator and large heat exchanger mainly for BWR (Boiling Water Reactor).

Major components applied in the nuclear turbine use are

employed of our own products, contributing to one of the reasons for maintaining high quality. Approximately 4,000 employees are deployed at Takasago Works and approximately 2,000 employees at Hitachi Works, engaging in design and manufacture of combined cycle plants or conventional thermal plants other than nuclear plants. Through efforts to share or utilize component technologies or supply chain, more efficient and more effective promotion of projects has been realized.

■ All Major Components in Turbine Plant are Manufactured In-House.

### Hitachi Works



#### Major Products

Steam Turbines  
Heat Exchangers  
Generators

### Takasago Works



#### Major Products

Steam Turbines  
Heat Exchangers  
PWR Turbine Plant

All Our Products Contribute Stable Electricity Supply.

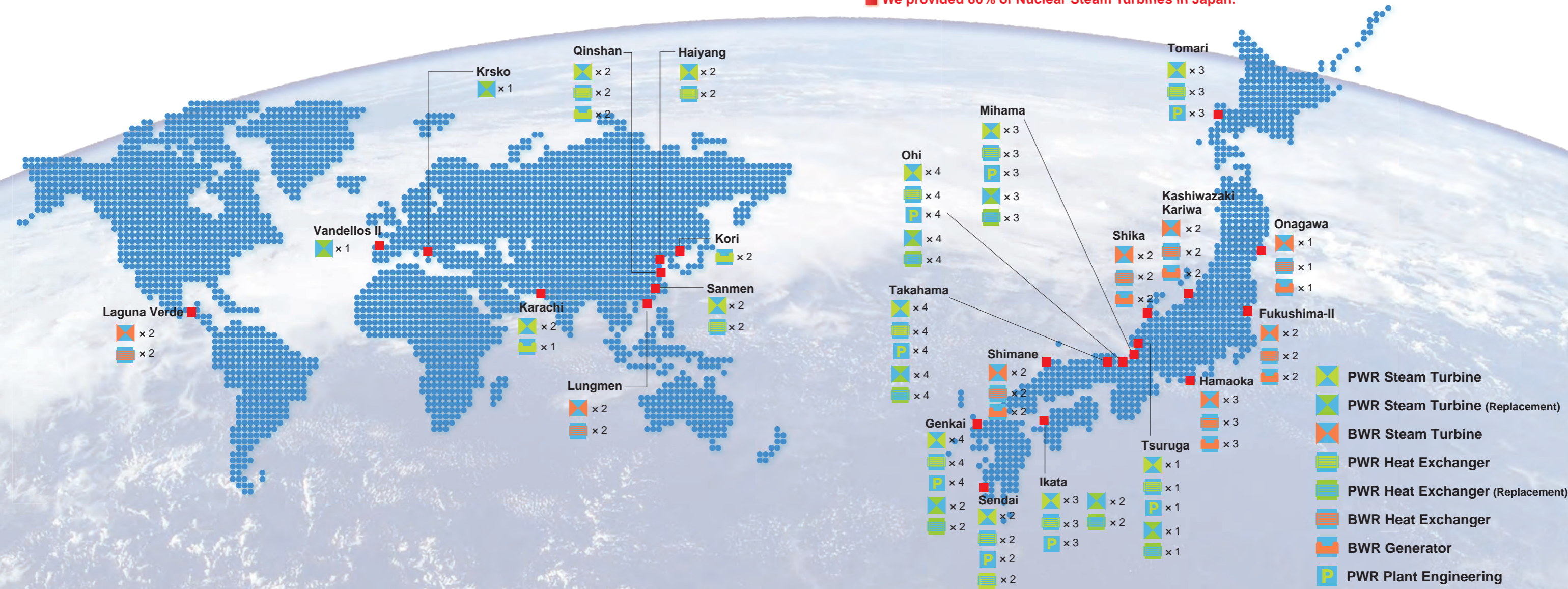
MHPS has been supplying turbine generator and turbine plant for nuclear plants since commercial operation of KEPCO (Kansai Electric Power Co.) at Mihama Unit1, and assures Customers of long-period of favorable operation track records. We supplied

steam turbines for all 24 domestic PWRs and for 12 BWRs, accounting for approx. 80% share of nuclear turbine generator in Japan. Services not only during plant construction but also after the commercial operation are available from MHPS.

Periodic inspection, maintenance and replacement of major components are also widely implemented. On the other hand, we have also track records of shipping out 12 units overseas. They are mainly shipment of steam turbine set, but we have received

high reputation of their craftsmanship out there. We have also experienced many Full Turn Key projects abroad of combined cycle and conventional power projects, based upon which we are capable to supply nuclear turbine plant, too, in a package proposal.

■ We provided 80% of Nuclear Steam Turbines in Japan.



Haiyang Nuclear Power Plant



Sanmen Nuclear Power Plant



Takahama Nuclear Power Plant



Sendai Nuclear Power Plant



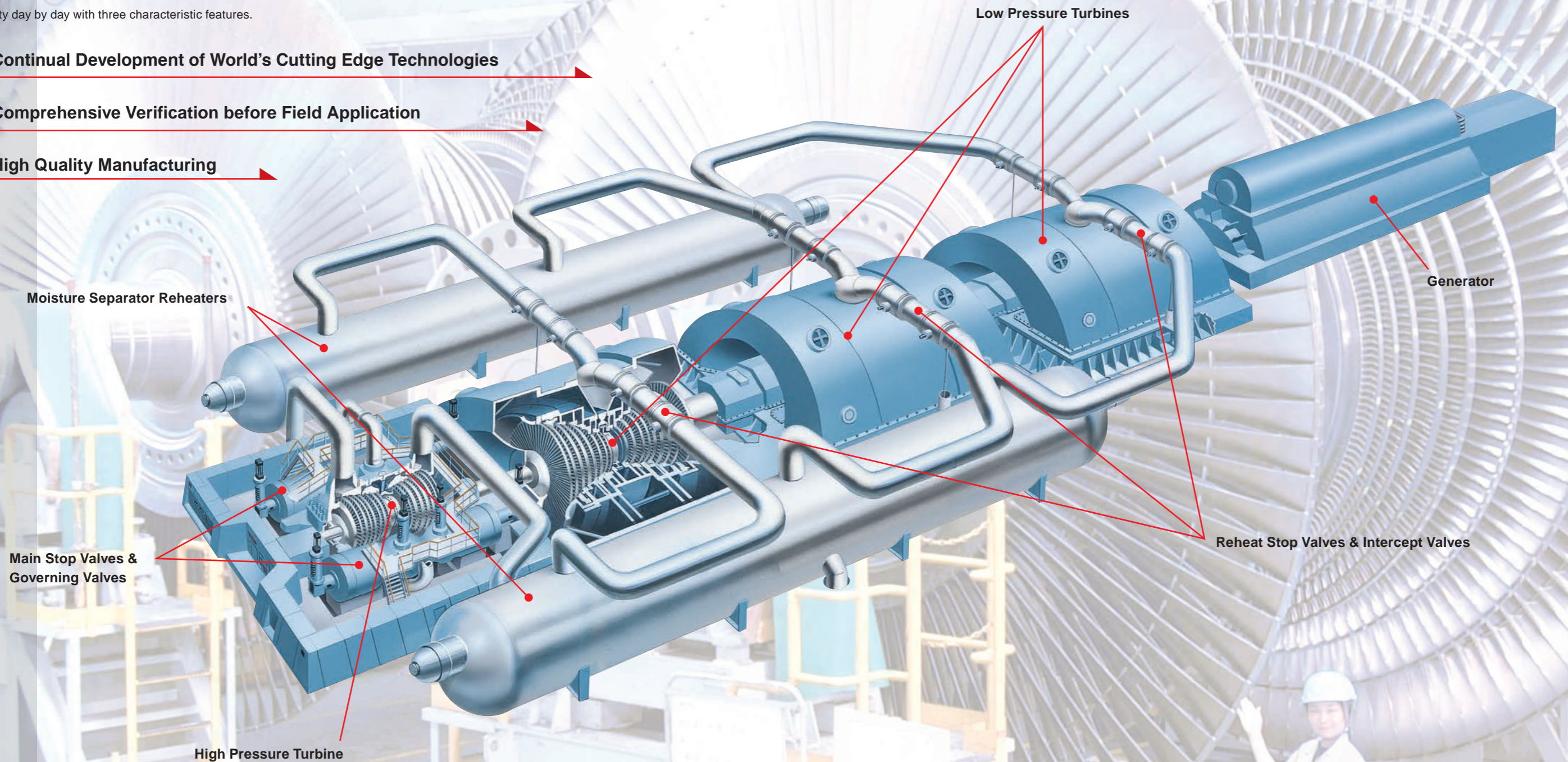
Genkai Nuclear Power Plant

# 2 In-House Products with Cutting Edge Technologies and High Reliability

## Steam Turbine

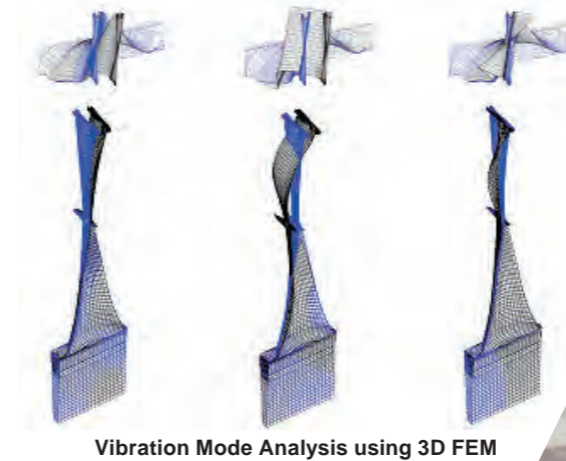
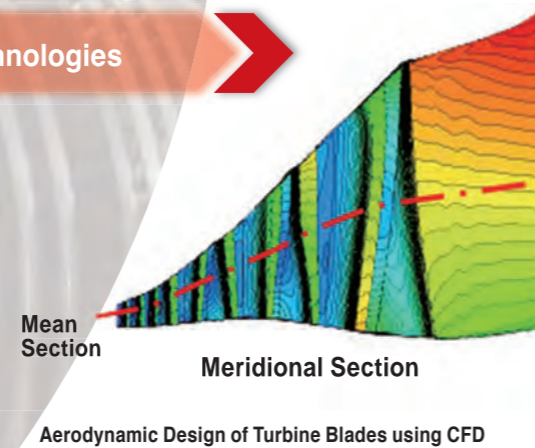
Steam turbine is the core component in turbine plant, which principally governs performance and availability of whole plant. MHPS has been developing its technologies and improving its reliability day by day with three characteristic features.

1. Continual Development of World's Cutting Edge Technologies
2. Comprehensive Verification before Field Application
3. High Quality Manufacturing



### 1. Continual Development of World's Cutting Edge Technologies

MHPS always develops its expertise to achieve the world's highest level of efficiency and reliability. We create state-of-the-art component technology, satisfying customer requirements in partnership with R&D center of MHI. We have come up with advanced blade by designing and analyzing with the use of CFD (Computational Fluid Dynamics) and FEM (Finite Element Method), and/or by carrying out tests/experiments, which are applied to our products.



### 2. Comprehensive Verification before Field Application

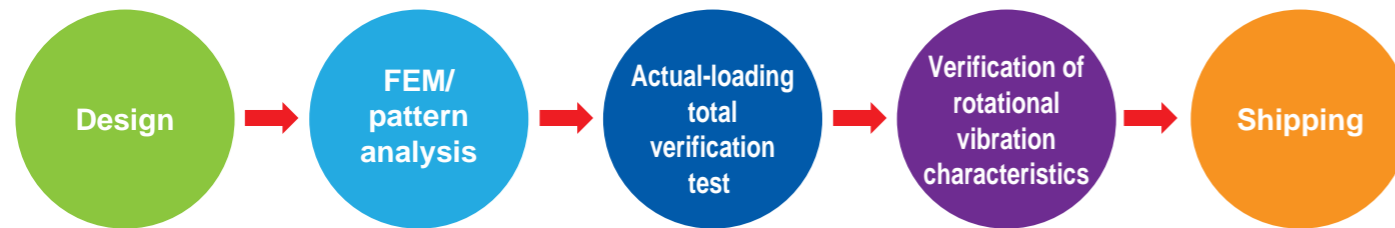
At MHPS, newly developed technology is verified prior to being applied to actual plants to secure its reliability.

In particular, the verification process of new turbine blade is established and proven through experiences of developing as many as 15 types of blades for the past 22 years.

Loading test by using steam is implemented at our Actual Loading Test Facility after 3D FEM simulation and flow pattern analysis. Vibration characteristics and performance are verified under the severer conditions than actual operating conditions with a 1/2 scale or higher test turbine.

And full scale test rotor is fabricated and tested to verify rotational vibration characteristics finally. Our Rotation Vibration Test Facility is capable to test rotors of 350tons, up to 8m diameter. This test is also carried out for each actual rotor before shipment.

Furthermore, MHPS owns combined cycle power plant at the premises. Performances and long-term operation reliability of both gas turbine and steam turbine are tested and verified.



### 3. High Quality Manufacturing

Strict quality assurance and control criteria is applied at our own shop for nuclear products like turbine rotor, blade and casing etc. In 2009, full-pledged factory exclusively for nuclear turbine was launched eyeing to enhance its quality further. In this factory, large rotor processing facility, large rotor welding facility and blade groove processing facility are equipped,

enabling to manufacture ten pieces of rotors a year. In addition, such equipment as 10,000ton class high pressure press facility and high-speed balance test facility, automated welding equipment and heat treatment facility are also available at MHPS for integrated production.



# World Leading Technologies

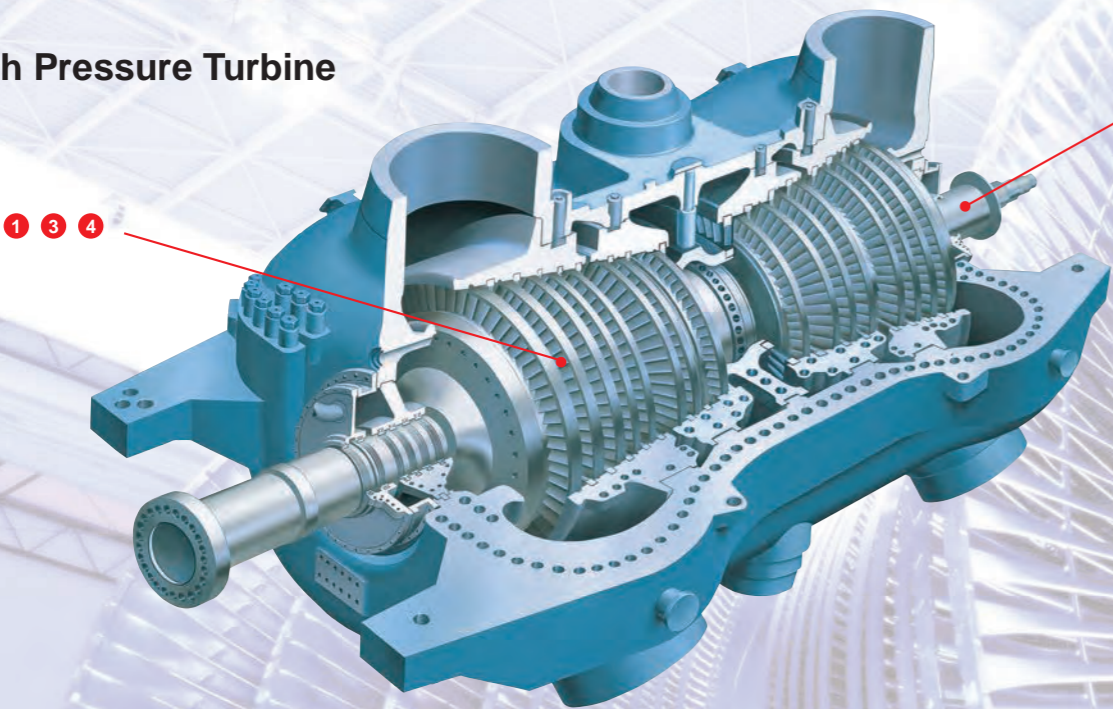
The latest technology contributes to the enhancement of reliability and performance.

## 1 Highly Efficient F3D Blades are applied.

F3D (Fully Three Dimensional) blades in which loss is minimized to the utmost limit have been adopted for rotating and stationary blades.



## High Pressure Turbine

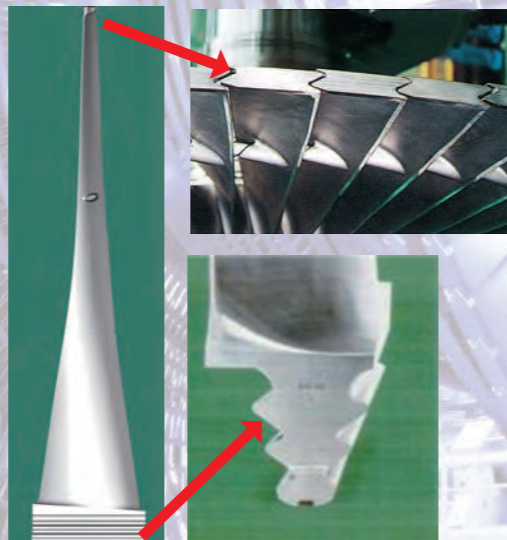


## 3 Low Vibration has been achieved by ISB/CCB Blade Structure.

Such structure as ISB (Integral Shroud Blade)/CCB (Continuous Cover Blade) retaining excellent vibration resistance and yet superior damping characteristic are adopted in all blades including low-pressure turbine last-stage blades. This allows reduction of vibratory stress on conventional blade to 1/5 through 1/10.

## 4 Large Root and Groove Design minimize SSC risk.

Blade root and groove are upsized compared with conventional blades in order to reduce centrifugal stress. Especially, SCC resisting performance in corrosive environment has been phenomenally upgraded.

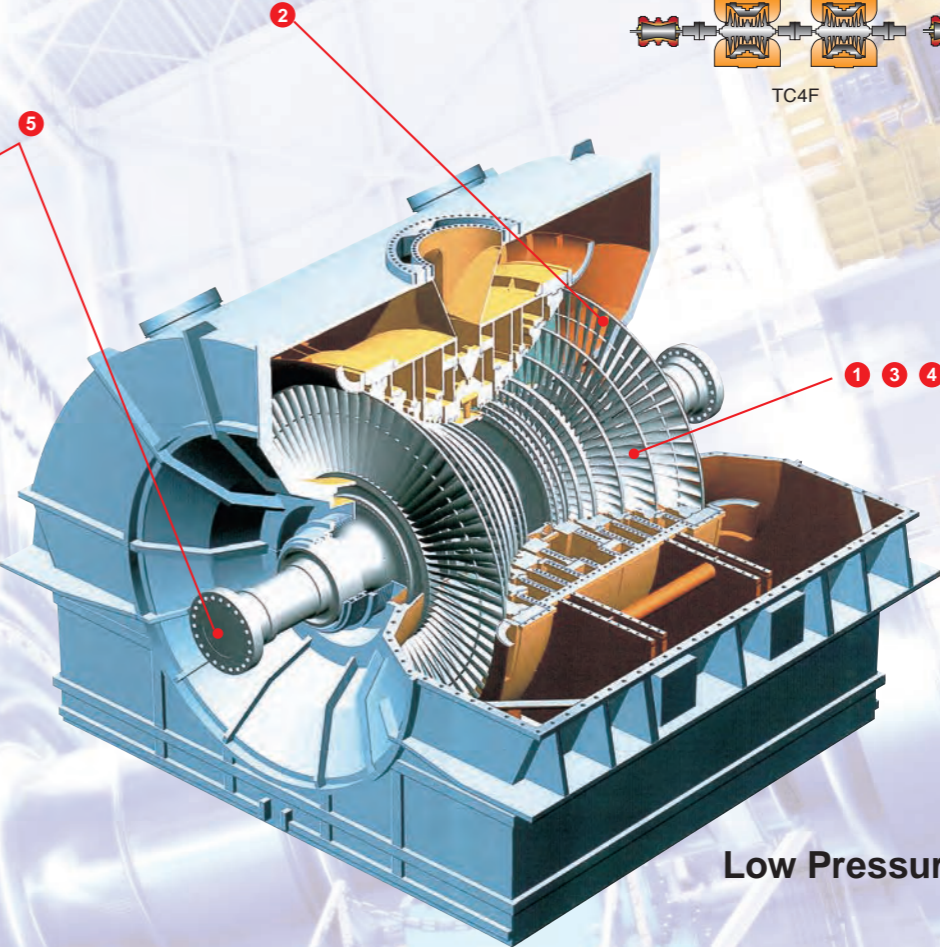
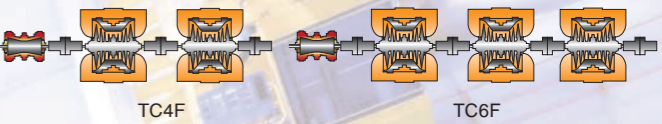


## 2 World's Longest Class Last Blade and Various Line-ups enhance the performance.

Last-stage rotating blade is abundant with its line-ups in order to meet various kinds of electrical output range to cope with reducing low-pressure turbine exhaust loss. We offer upto world's longest 74" last blade according to plant application.

For 50Hz Machine(1,500rpm)

Last stage blades (in.)	Rated Output (MWe)						
	400	600	800	1000	1200	1400	1600 1800
49	TC4F TC6F						
54	TC4F TC6F						
65	TC4F TC6F						
74	TC4F TC6F						



## Low Pressure Turbine

## 5 Both Mono-Block and Welded Rotor are available.

Mono-block rotor or welded rotor is adopted for nuclear turbine rotor used in corrosive environment. Concerns over SSC have been

largely eliminated by reducing disc stress by abolishing shrunk-on and keyway disc structure.



Welded Rotor (for thermal plant)



Mono-block Rotor

## Major Components

MHPS designs and manufactures major components such as heat exchangers, generators, and pumps, all of which are important for plant performance and reliability, at its own shop. We can supply them for large turbine plants up to 1,700MWe class.

## Heat Exchangers

### [Condenser]

Condenser maintains low pressure turbine back pressure (vacuum) by condensing exhaust steam from low pressure turbine through cooling water.

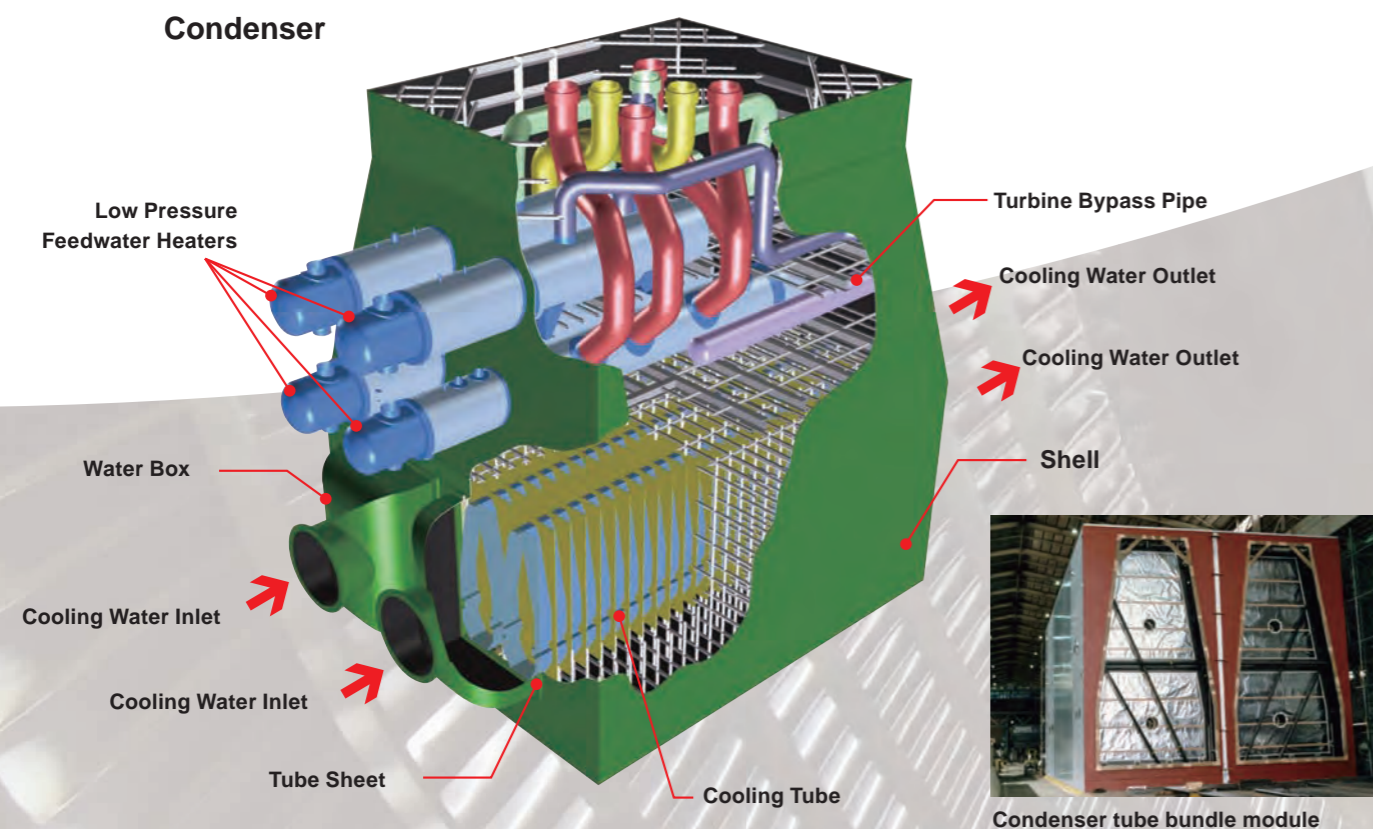
Design conditions of Condenser come with abundant variations depending on various site conditions of power plants. Tube bundle arrangement that affects condensation performance is optimally designed, taking into account steam flow, inundation or sub-cooling etc. Two types of tube bundle arrangements are available; one is has radial flow arrangement where steam flows towards the center of tube bundle, and the other is down flow arrangement where steam flows downward. Cooling tube use titanium tube with erosion/corrosion resistant thin wall as standard, but if cooling water is fresh water, stainless tube might be selected. Cooling tubes are expanded and seal welded to tubesheets to avoid leak.

Optimum Condenser type for each site is selected from Single-pass / Double-pass type, or Single-pressure / Multi-pressure type, etc. in

accordance with the cooling water conditions.

Inside the shell-skirt of Condenser, LP (Low Pressure) feedwater heaters are installed. (Neck heater) This contributes to compact turbine building, to shorten the length of extraction pipe and feedwater pipe, and to minimize steam pressure drop through extraction pipe to LP feedwater heaters. Turbine bypass pipe is installed so that the excess steam during plant transient conditions could be dumped into Condenser.

Water box, tubesheet, cooling tube and tube support plates are arranged at the shell, where low pressure turbine exhaust steam is condensed. The condensate is collected in hotwell which takes a role as reservoir for Condensate Pump, as well as receiver of excess drains at abnormal operation.



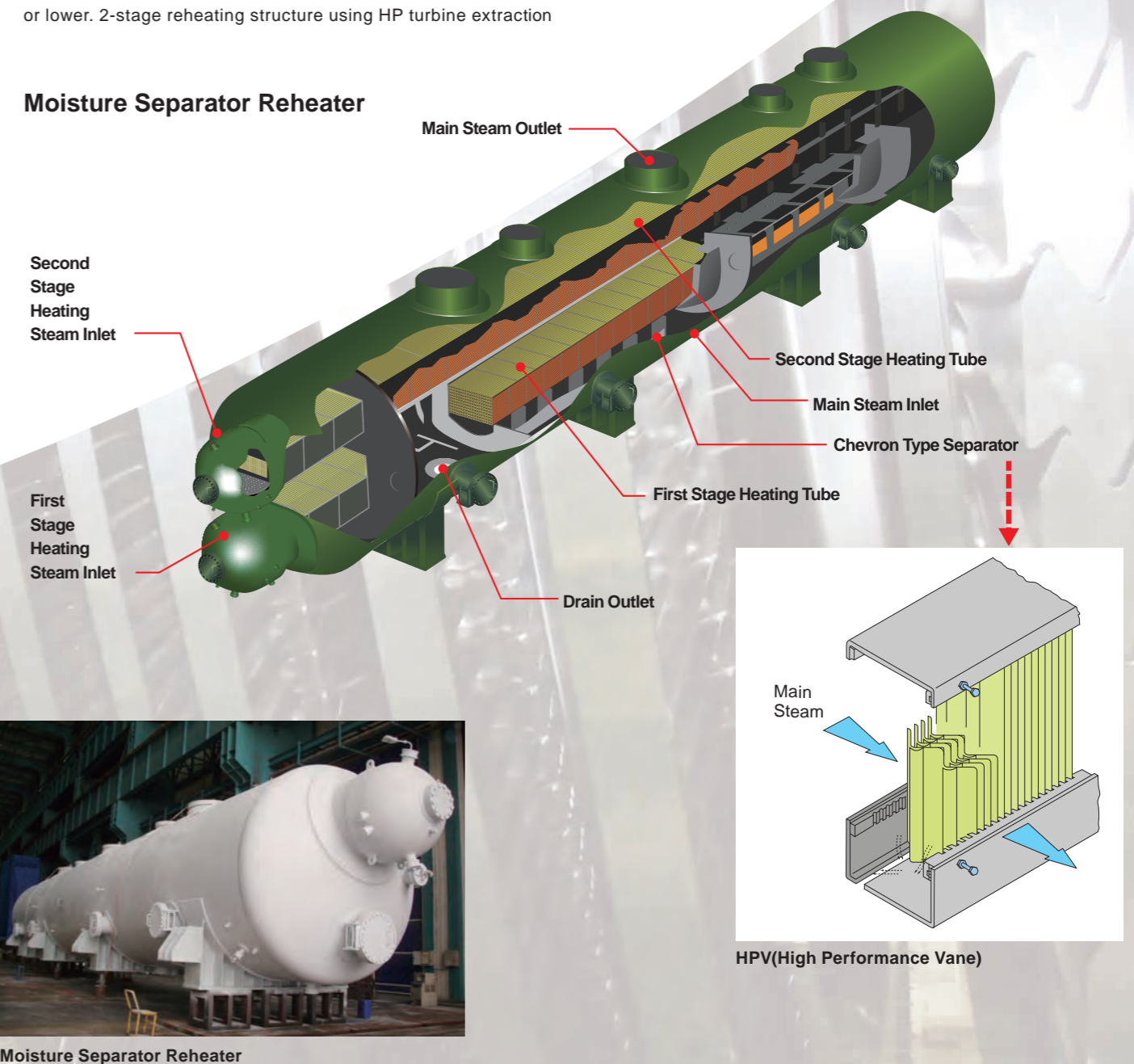
### [Moisture Separator Reheater]

Moisture Separator Reheaters (MSRs), which are installed between HP (High Pressure) and LP (Low Pressure) turbines, are heat exchangers to remove moisture and to reheat the steam from high pressure turbine. By using MSR, erosion/corrosion on LP turbine blade is prevented and approx. 2.5% of plant efficiency is enhanced..

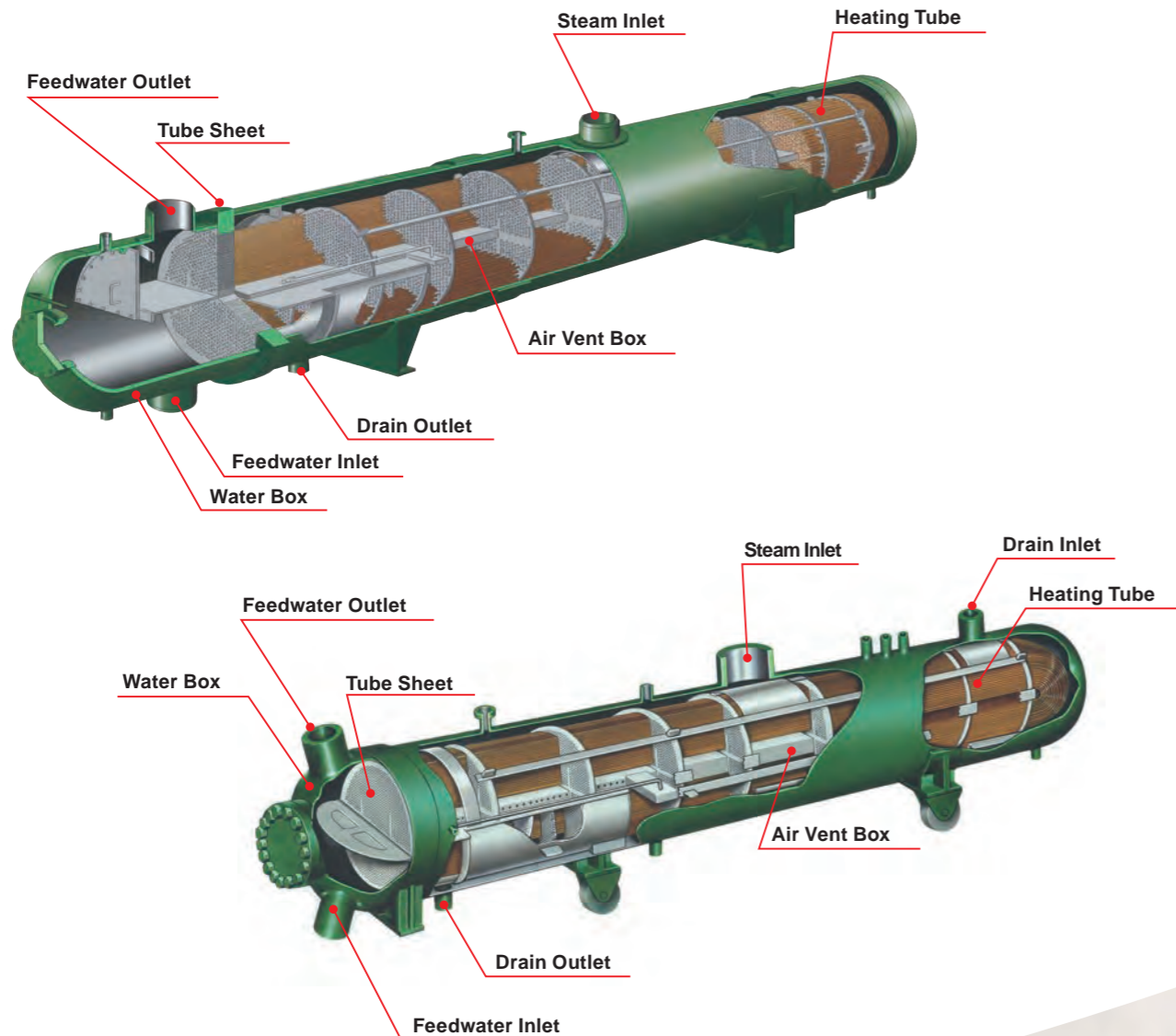
HPV (High Performance Vane) developed in-house is applied as moisture separator to realize the residual moisture content of 0.25% or lower. 2-stage reheating structure using HP turbine extraction

steam and main steam is employed to gain high efficiency. The reheaters use fin tube made of ferrite stainless steel taking maximization of effective heat transfer area and manufacturability into account.

## Moisture Separator Reheater



### Low Pressure Feedwater Heater



### High Pressure Feedwater Heater

#### [Feedwater Heater]

Feedwater heater is a shell & tube type heat exchanger, which heats feedwater by turbine extraction steam through heating tubes. Feedwater heaters which receive extraction steam from HP and LP turbine are called HP and LP feedwater heaters, respectively. Such a structure as drain cooling zone for heat exchange between extraction drain and feedwater is installed in the shell. The heating tube material is stainless steel having superior corrosion resistance.

The heating tube is expanded and seal welded to tubesheet as prevention against leak. (HP feedwater heater)  
In general, LP feedwater heaters are installed at shell skirt of Condenser in 2 to 4 stages, contributing to compact design of turbine building.

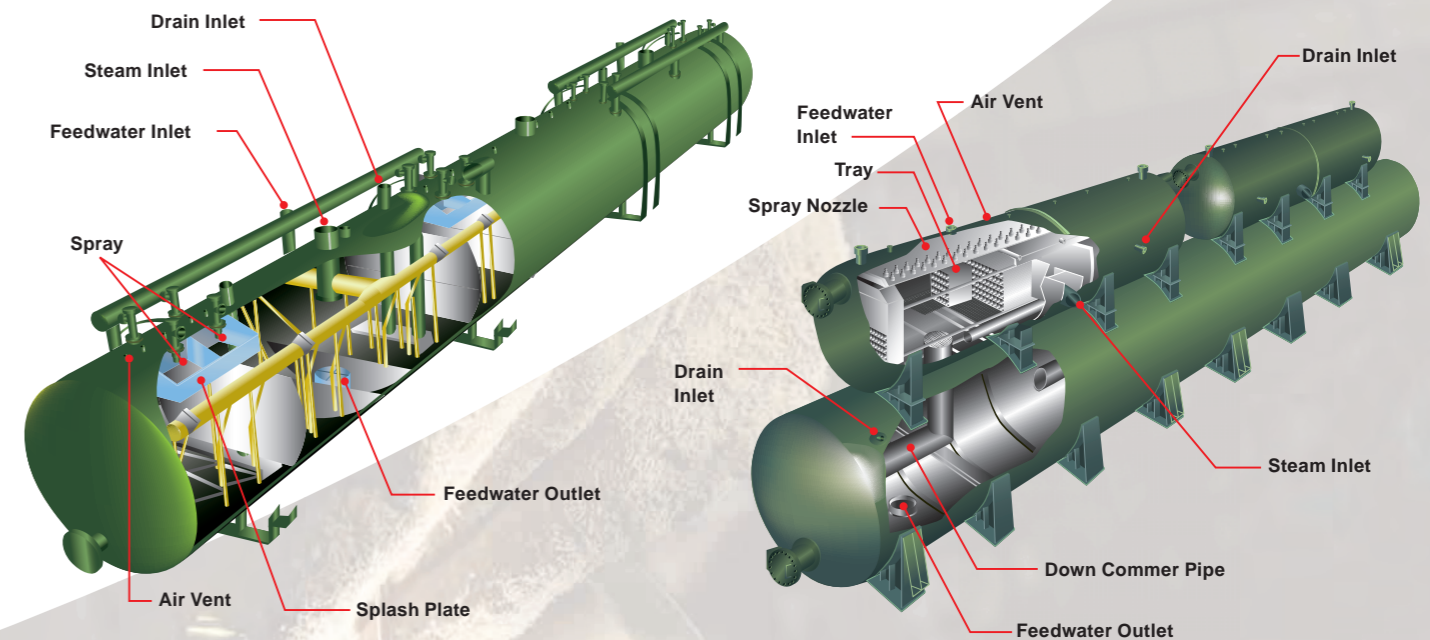
#### [Deaerator]

Deaerator is a heat exchanger where condensate is heated up through a direct contact with turbine extraction steam, as well as it deaerates dissolved oxygen in the condensate to 5 ppb or lower. MHPS can supply two types of Deaerator; one is double shell type deaerator, consisting of a deaerator heater with spray nozzle and deaerator tray and storage tank, and the other is single shell type deaerator housing spray nozzle and sparger pipe in storage tank together.

The double shell type deaerator is constructed so that condensate

water is sprayed from the topmost part of the deaerator. While the condensate is dropping down from the tray, the condensate is heated by extraction steam and is deaerated. The condensate is then stored in large-capacity storage tank placed right below the deaerator heater.

The single shell type deaerator, is constructed so that the condensate is heated, deaerated and stirred by directly injecting steam into stored feedwater in the tank, as well as condensate is sprayed from the topmost part of the deaerator.

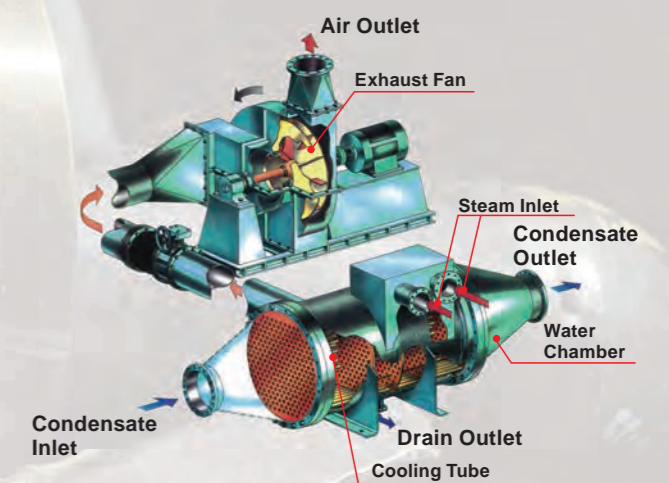


#### Single-Shell Type Deaerator

#### Double-Shell Type Deaerator

#### [Other Heat Exchangers]

MHPS also manufacture other kinds of heat exchangers which are important for the operation of steam turbine or turbine plant, such as Gland Steam Condenser & Exhaust Fan, Lube Oil Cooler, Cooling Water Cooler.



#### Gland Steam Condenser & Exhaust Fan

## Large Capacity Generator

MHPS manufactures large capacity Generator for nuclear power plants.

Generator is directly coupled with steam turbine rotor, and converts dynamic energy from steam turbine into electrical energy. Generator mainly consists of stator and rotor having core and coil. Hydrogen, superior in cooling characteristics, is used as coolant. It cools down rotor windings and stator core by ventilating autonomously with help of cooling fan fixed to the rotor. In addition, cooling water is provided to cool stator winding through hollow copper, where large current flows.

Design of Generator is well evaluated by applying the latest technology and tools in electromagnetics, thermodynamics, hydrodynamics, vibrational dynamics, and mechanical engineering, and is verified through design review. Strict quality control is implemented in each manufacturing process of machining and assembly, especially for insulation and electrical work which

enhance reliability. At the last stage of manufacturing, stator and rotor of Generator are assembled at our own shop, and tested in accordance with international codes & standards to demonstrate the performance meets the requirements.

MHPS has experiences of large capacity Generator having as much as approx. 1,600 MVA. We are still continuing development of advanced technology so that we can cope with further upsizing of nuclear plant.



1,570MVA Nuclear Turbine Generator

## Major Pumps

Main feedwater pump, Circulating water pump and Condensate pump are the major pumps in turbine plant. MHI/Hitachi provides these pumps for MHPS.

Main feedwater pump, working together with Feedwater booster pump, delivers feedwater from Deaerator to Steam Generator or Reactor Vessel. Its capacity is large and suitable for use under high pressure and high temperature conditions.

Main feedwater pump is made in single stage / double suction / double volute type, driven by the electric motor or steam turbine, and could be usually installed with 3 or 4 sets with the capacity of 33%-50% in accordance with the plant size. Main feedwater pump and feedwater booster pump can be arranged on the same drive axis or separately.

Circulating water pump delivers cooling water to Condenser. It is constructed vertically for mixed flow with large capacity and low

head. MHI is capable of manufacturing world's largest type Circulating water pump, which enables the installation with 2 sets of 50% capacity pump (in the case of seawater cooling) contributing to downsizing of intake pit and pump house. Circulating water pump of variable pitch vane type could also reduce the running cost by optimizing the vane angle in accordance with operation conditions.

Condensate pump delivers the condensate water to Deaerator through Condensate Polisher and Gland steam condenser. Condensate pump is made in a vertical pit barrel type with multi-stage, driven by the electric motor, and could be installed with 3 sets of 50% capacity.



Main Feedwater Pump (MHI)



Circulating Water Pump (MHI)

# 3 Turbine Plant achieving High Performance, Availability, and Maintainability

## Heat Cycle is Well-Tuned and Optimized.

PWR turbine plant employs 2-stage reheat, 7-stage regenerative condensate cycle as standard heat cycle to achieve high efficiency. Turbine plant receives steam from Reactor building and converts its energy to electricity at steam turbine generator. A part of the steam flows to Moisture separator reheater (MSR) in order to reheat main cycle steam. Some amount of steam is extracted from intermediate stage of steam turbines, and is used for heating feedwater at feedwater heaters. Parameters of heat cycle are well tuned and optimized so that maximum efficiency could be achieved. Figure on the next page illustrates flow diagram of turbine plant for PWR. Main steam generated at Steam Generator is lead to Turbine building through main steam pipe. Main steam enters into HP turbine through Main Stop Valve (MSV) and Governing Valve (GV) for work, and then it is depressurized. After that, it is reheated at

MSR, and goes into LP turbine through Reheat Stop Valve (RSV) and Intercept Valve (ICV). The exhaust steam from LP turbine is condensed at Condenser by cooling water. This condensate is boosted by Condensate pump to Deaerator, and is heated through 4-stage of LP feedwater heaters and at Deaerator.

The feedwater from Deaerator is sent to Steam Generator by feedwater pump through 2-stage of HP feedwater heaters. Steam used for heating main cycle steam or feedwater is condensed into drain. The drain is collected and recovered into feedwater line so that heat efficiency could be increased.

## Plant Design achieves High Reliability, Availability, and Maintainability.

MHPS nuclear turbine plant have high reliability as it incorporate our long period operational experiences into the system or component design. In order to maintain plant availability under normal operation, sufficient design margin is considered in the design and spare machine or backup system is provided. In abnormal events like sudden load drop, a function to protect equipment and to shutdown the plant safely is provided. All necessary actions against past incidents are reflected into the design.

Next, the plant is designed taking operationability and maintainability into account by the stand point of customer. Inspection/maintenance/replacement of components during operation (in-service inspection: ISI) is available as well as the necessary space for daily maintenance and inspection is provided. Moreover, sufficient space is prepared for disassembling components such as turbine during periodic inspection. Two sets of overhead cranes are installed to shorten the inspection period as standard design.

In addition to these, MHPS tries to reduce initial construction cost. Although, in accordance with increase of electrical outputs, compact design has been realized minimizing the enlargement of turbine building and material increase of

components while securing required space for maintenance. Also, equipment and maintenance cost have been reduced as such applying motor driven feedwater pump or eliminating condensate booster pump.

Sharing of various data and concurrent engineering are realized by introducing 2D/3D-CAD and database as design tool. Especially, due to introduction of pipe-layout-design using 3D-CAD modeling, it becomes available not only to avoid interferences of pipe routing, but also to check maintainability and operability visually together with Customer before starting construction. At the same time, change or modification works at local could to be largely reduced.

## General Arrangement in Turbine Building is so Functional and Optimized

Turbine building that houses turbine plant is steel –framed (underground is reinforced concrete structure), and configured in 4 stories above ground and 1 story underground. (It could be 3 stories above ground and 2 below depending upon site conditions)

Turbine building is non-safety building, but it should be designed such that it could not cause a secondary damage to Reactor building due to external factors like earthquake, floods, inundations or tornados.

Steam turbine and Generator are installed at the 4th floor of the Turbine building with 2 sets of MSR beside. Condenser is installed right beneath LP turbines, and LP feedwater heaters are installed in Condenser shell skirt.

Feedwater pumps are located at the 1st floor, and Deaerator, the water reservoir for feedwater pump, is installed at higher level than 4th floor in order to maintain required NPSH (Net Positive Suction

Head) of the pump. Condensate pump is installed at underground floor where NPSH from Condenser hotwell could be maintained.

At the 4th floor where turbine is installed, lay-down space required for overhaul inspection of turbine is ensured. Open hatch is provided at the corner of Turbine building in order to facilitate carry-in & out of large components for their repair/replacement.

Arrangement of components is studied and determined such that daily inspection/periodical maintenance could be facilitated as well as individual functions of system and components could be satisfied. In addition to these, piping and cable routing is well optimized to reduce amount of materials.

## We meet with Specific Requirements and Conditions.

Of primary importance at planning stage is optimum design of heat sink. Design of cooling water system differs from meteorological and geographic conditions of the plant site, and largely affects construction/operation costs and layout. (exa. open cycle or closed cycle, sea water or river water) We offer the most advantageous proposal of cooling water system after studying several candidates of the systems.

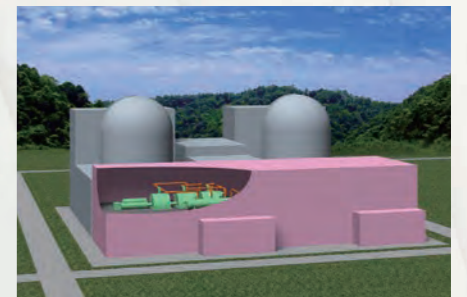
Physical location of Reactor building and Turbine building is important. In standard design, Turbine building is oriented so that the turbine shaft is directed toward Reactor building (I-type layout). In the case where site land preparation of the I-type layout is difficult due to steep configuration of the site geography, the turbine shaft is oriented 90 degrees towards the Reactor building (T-type layout). Routing of cooling water pipe and location of intake & discharge pit are reviewed together. In the case where more than one unit are to be constructed in the same identical site, plot plan around Reactor building must be so studied by taking common utility facilities and missile protection into consideration.

In addition to the above, we will offer specific design and proposal upon Customer needs. Saving operator's load could be given as one of them. Our turbine plant is designed such that start and stop operation of major auxiliary components like pumps, open/close of large valves, and operation of frequently used components can be remotely operated from the Main Control Room. Moreover, function to automatically collect principal operation data at main control

room could be provided. In generally, the range of these labor saving and remote operation are not so large compared with those of thermal power plants, however, it could contribute to reducing number of overnight personnel and alleviating work load of operators.

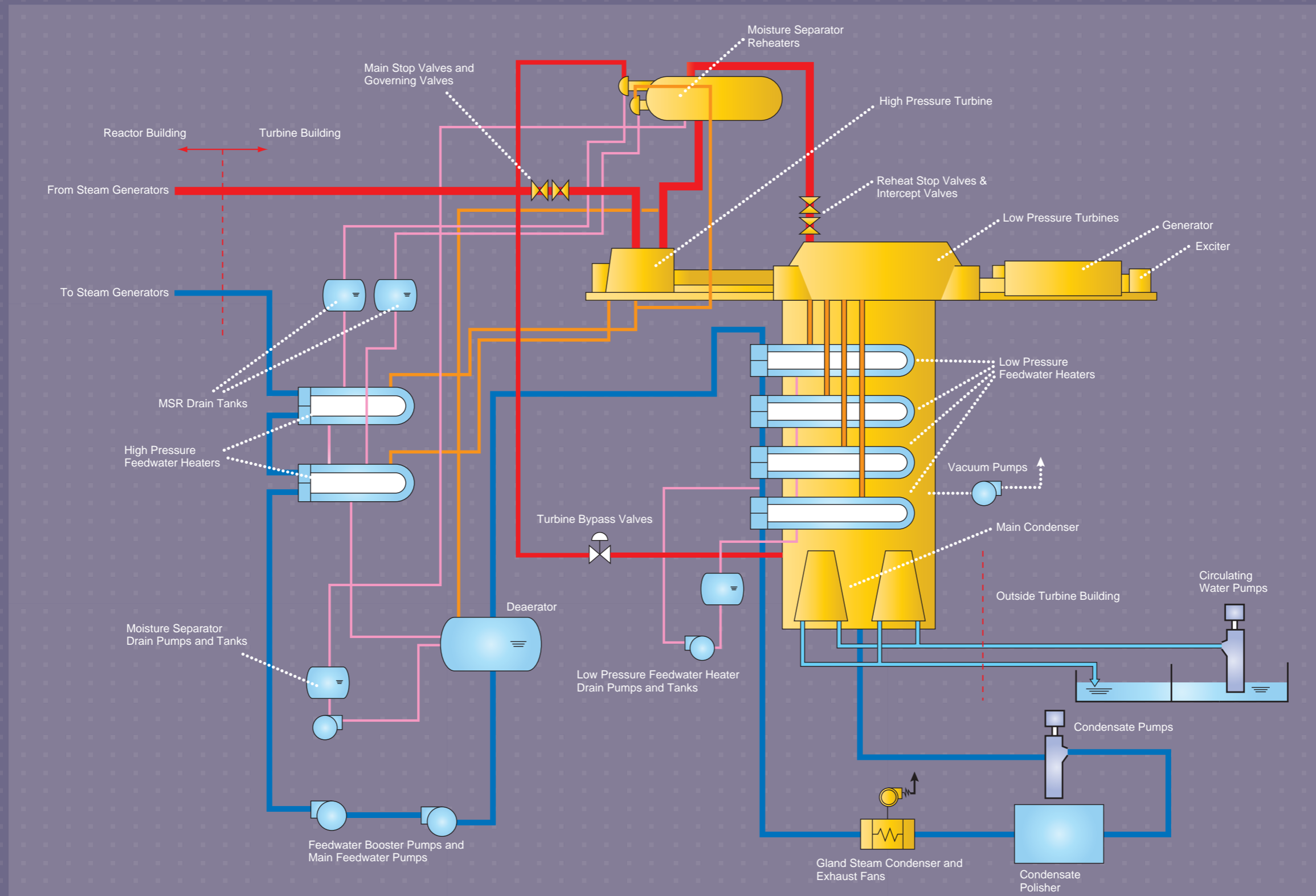
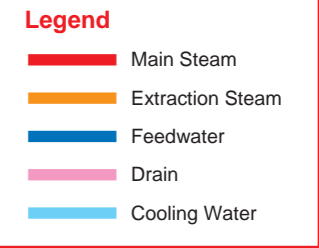


I-shape Layout

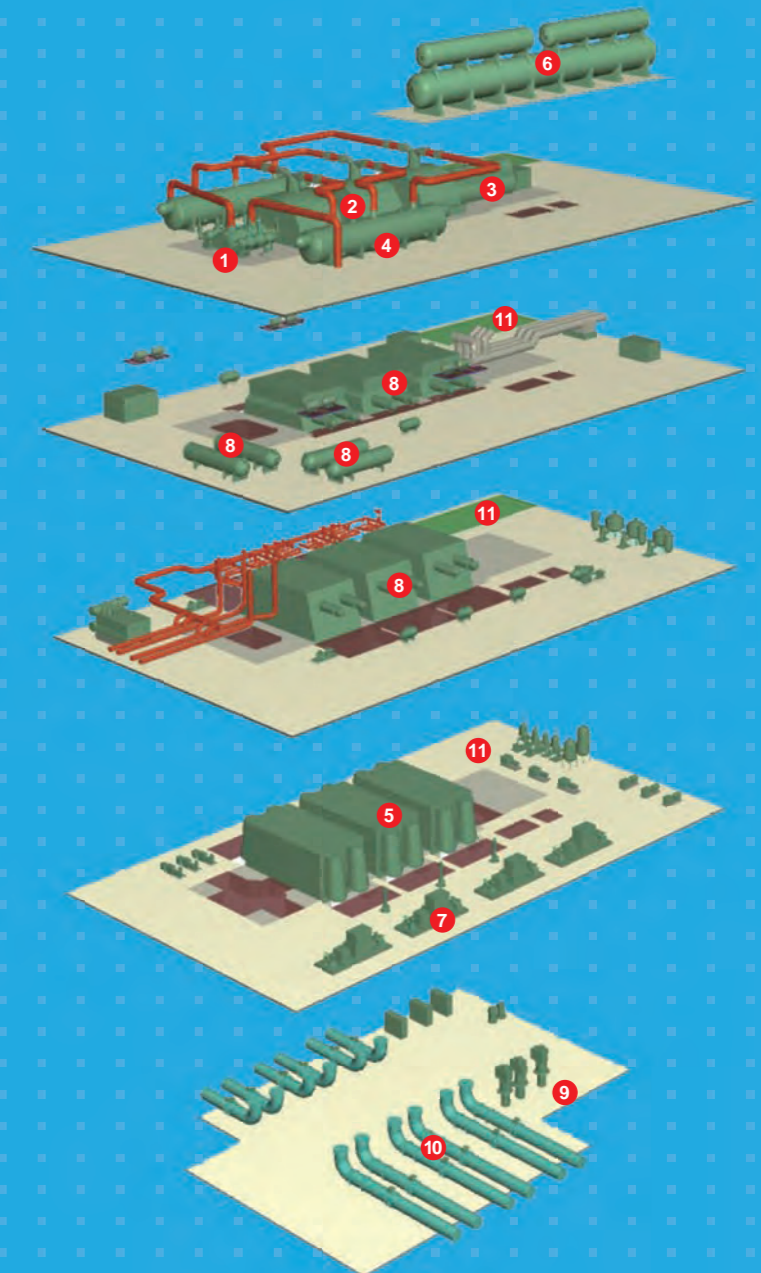
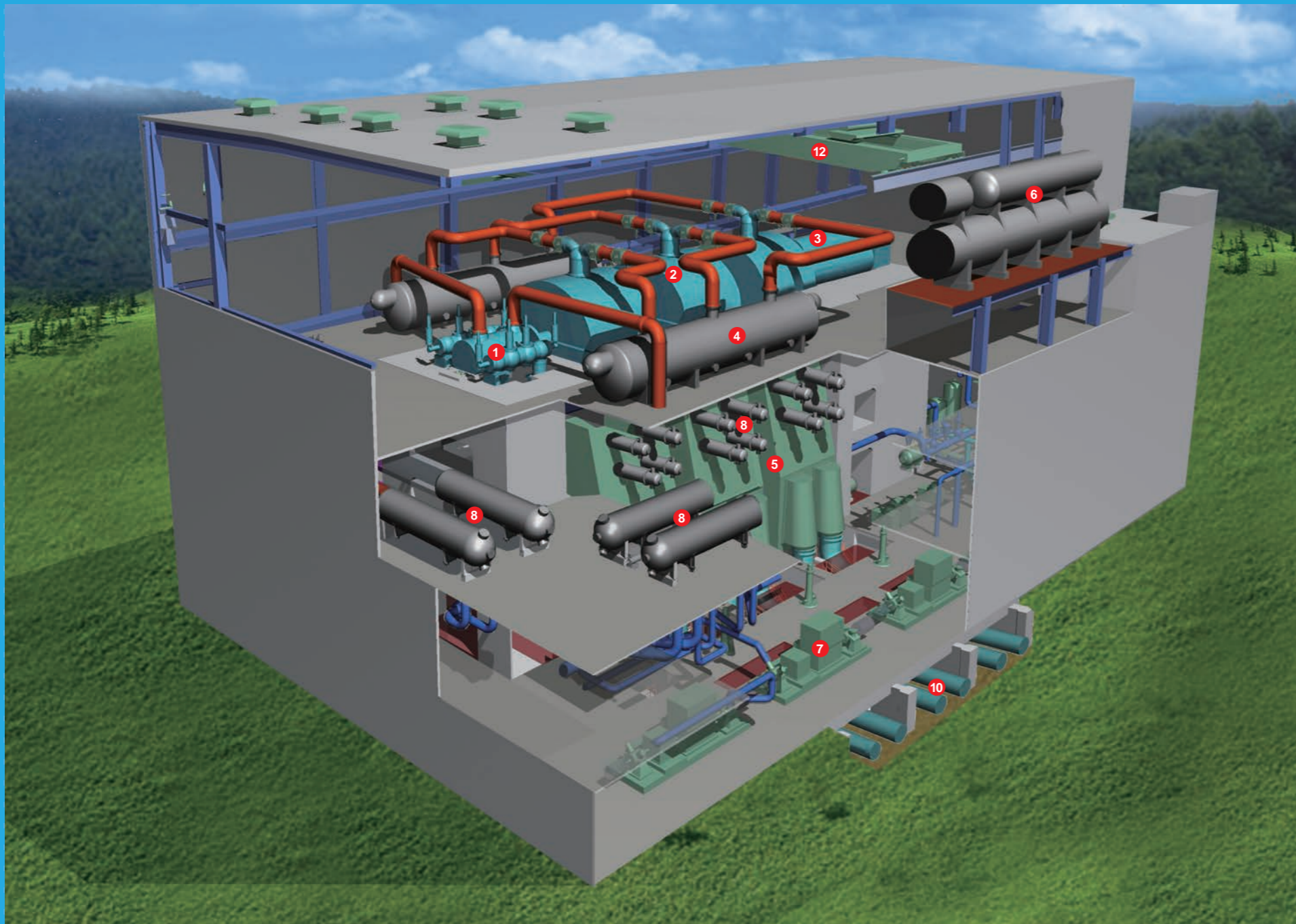


T-shape Layout

# Nuclear Turbine Plant System Flow Diagram for PWR



# Turbine Building and Component Layout for PWR



- |                               |                        |
|-------------------------------|------------------------|
| 1 High Pressure Turbine       | 9 Condensate Pumps     |
| 2 Low Pressure Turbine        | 10 Cooling Water Pipes |
| 3 Generator                   | 11 Open Hatch          |
| 4 Moisture Separator Reheater | 12 Overhead Cranes     |
| 5 Main Condenser              |                        |
| 6 Deaerator                   |                        |
| 7 Feedwater Pumps             |                        |
| 8 Feedwater Heaters           |                        |

# 4 Total Engineering from Planning to Maintenance

## Ask us anything on Turbine Plant.

MHPS has built up plant total EPC (Engineering, Procurement, and Construction) capability through vast experiences and excellent performances of thermal and nuclear power plants, which is now well recognized by Customers around the world. MHPS can offer any services including basic planning, basic design, detailed design, procurement, manufacture, construction, commissioning and maintenance service of turbine plant.



Inquiry

Basic Plan/  
Price Estimation

Contract

Basic Design /  
Detailed Design

Procurement

### Basic Plan/ Price Estimation

MHPS offers basic plan and price estimation of turbine plant or components that suits customer's required specifications. Feasibility studies at initial planning stage can also be conducted.

### Basic Design / Detailed Design

We design structures, systems and components which meet contract specifications. 3D modeling method integrated with database is applied for space design, aiming at highly efficient designing. This method helps not only to enhance operability and maintainability, but also to remarkably reduce reworks at local site. Special verification process is taken in case the FOAK (First-of-a-kind)

design or technology is adopted. Senior experts from a lot of engineering fields take part in this review, and verify from several viewpoints such as manufacturability, operability, and reliability. In addition to calculations and simulations, the new technology is confirmed to function properly through laboratory mockup test or at plant commissioning test.

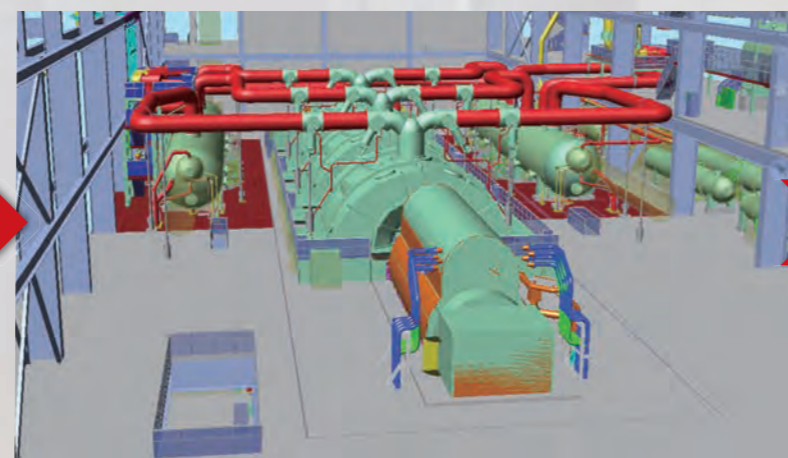
### Procurement

MHPS has established worldwide supply chains to provide high quality products and services. Equipment suppliers to nuclear turbine plant are qualified and listed by MHPS. Especially, major components such as pumps and heat exchangers, which are important for plant reliability, are purchased from vendors who have sufficient supply experiences to nuclear power plants. Procurement activity can be effectively conducted through MHPS global network.

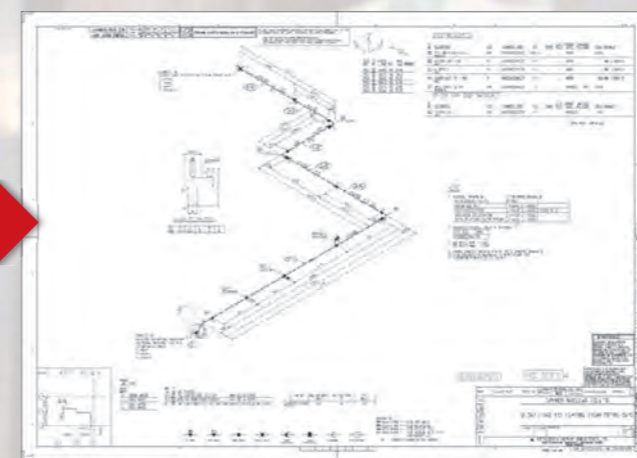
We collaborate with vendors, studying their various proposals, so that we can facilitate short-term delivery at reasonable prices. Working in collaboration with the local companies is also developed. They are very familiar with local regulations and standards to be applied, especially in civil engineering work.



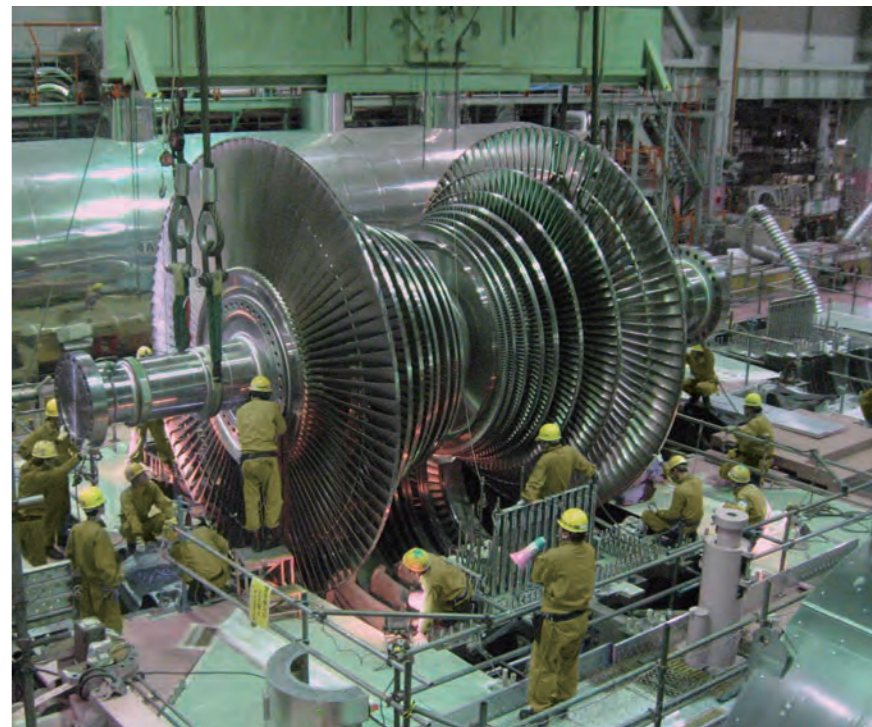
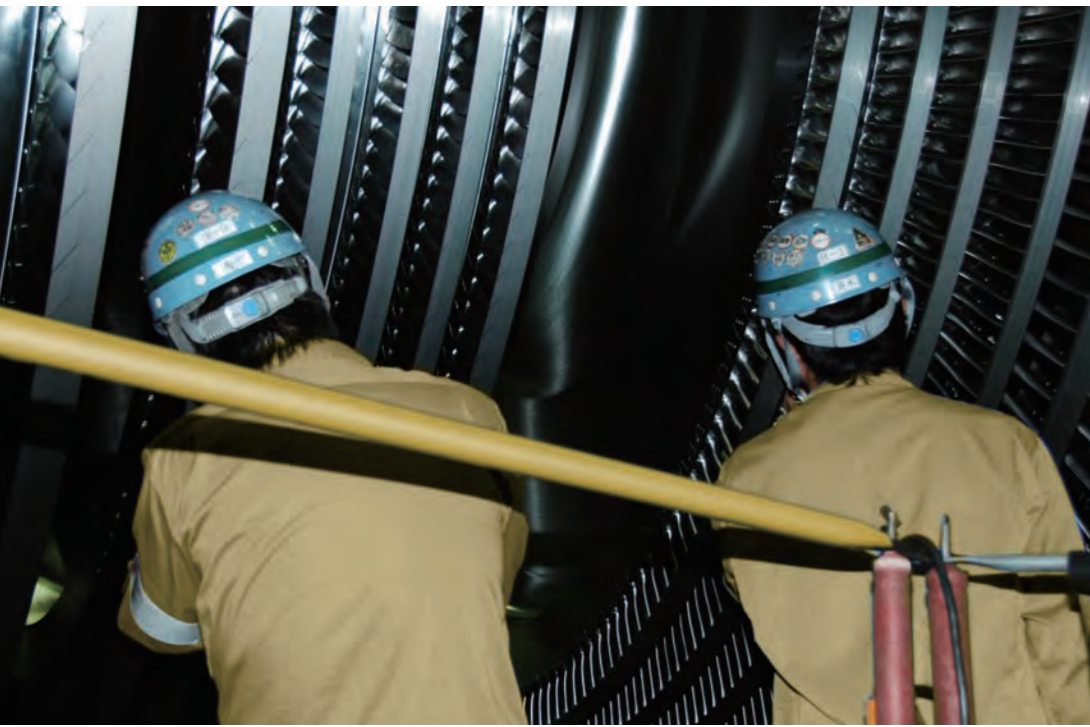
System Diagram (P&amp;ID)



3D Model



Piping Fabrication Drawing



## Manufacture and Fabrication

## Transportation

## Construction

### Manufacture and Fabrication

Major products like steam turbines and MSRs are manufactured and assembled in our own works.

Procedures and instructions for manufacturing / fabrication are established as company standard, but those technical know-hows that are hard to put into words need to be passed over by traditional human interactions. To further promote this movement, MHPS has launched "Education and Training Center of Technical and Human Skill," where well skilled workers hand down their expertise to younger generations aiming to enhance techniques. Step-up

education for senior employees is implemented to further improve their specialty.



### Education and Training Center of Technical and Human Skill



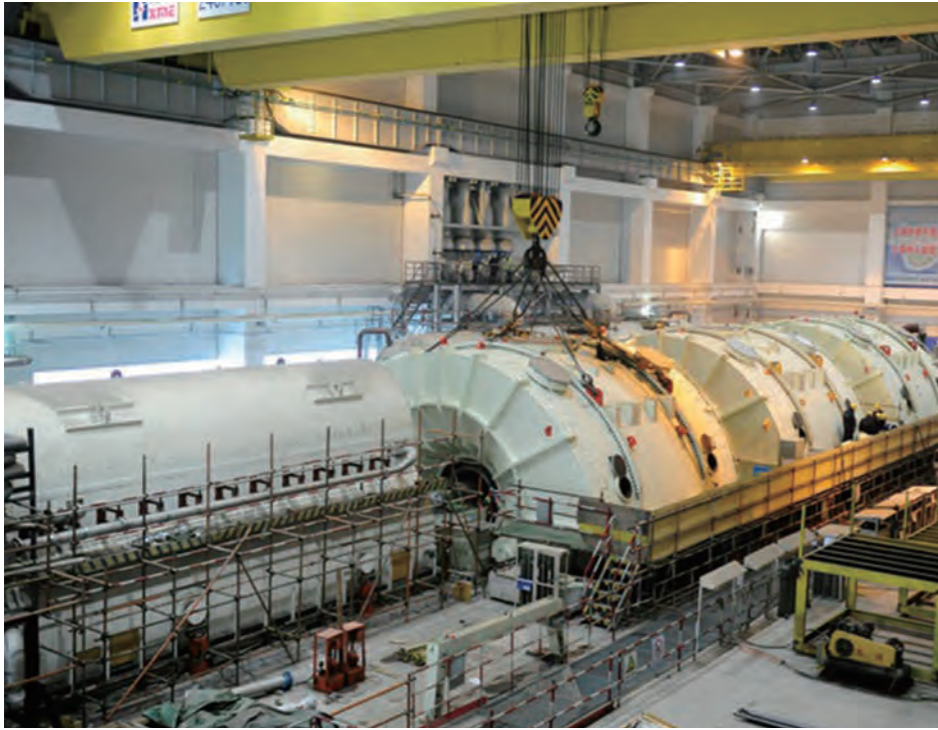
### Construction

We implement site preparation, building construction, and installation of facilities / components. In order to shorten the construction time, several construction methods are adopted. Components are pre-fabricated with piping and valves at shop or site into a big module, and they are installed by using super-crane. Also, simultaneous construction procedure, which building work and installation work are executed at the same time, is applied. Compared with the conventional method, carry-in of bigger component module could be available. Further, pre-fabrication of

steel structure shipped with temporary parts to steel frame / beam contributes to reduce construction period at site.

Schedule management is important to keep a target schedule. We, together with Customer, have Progress Meeting periodically, and timely and effectively mobilize workers or machines. Such work progress information is shared with Customers and other partner companies by utilizing of recent schedule managing tools.





Commissioning

Maintenance Service

Commissioning

At the final stage of the plant construction, commissioning of the components and systems is performed. Our startup engineers with plentiful skills and experiences train customers' operators to let them surely master functions, controls, operations, and daily inspections of MHPS nuclear turbine plant.

Moreover, we offer classroom training sessions to educate system design philosophy, abnormal operation and limitations, and component maintenance. Upon request by Customer, we will arrange special trainings - maintenance training at vendor shop or operation training at simulator facilities, etc.

Maintenance Service

Even after commercial operation of the plant, MHPS would be a good partner with Customers of maintenance services.

As general maintenance service, we supply consumable parts and spare parts, dispatch technical advisers or supervisors for disassembling and inspection, and implement work at periodic inspection as well as we recommend the inspection and replacement items at the next outage.

We propose long-term maintenance menu. It widely covers engineering supports such as plant performance evaluation and monitoring of pipe wall thinning, replacement of large components such as turbine generator and heat exchangers, and system modification to add heat recovery systems.

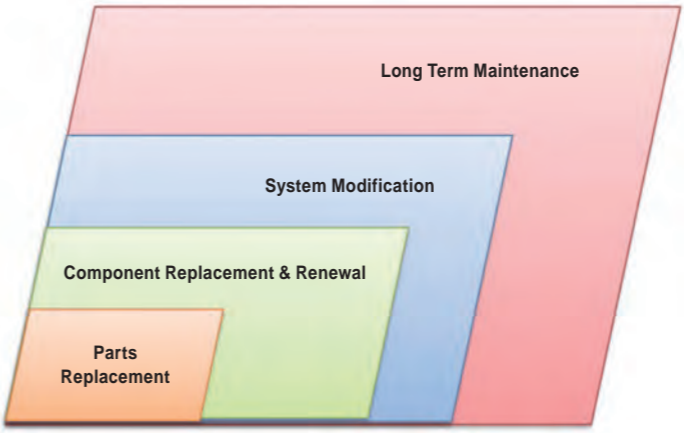
MHPS has provided lots of these services home and abroad through our total engineering and manufacturing capability.

MHPS will solve Customer's needs to improve plant performance, availability, reliability, and operability as well as to reduce maintenance cost throughout plant life

MHPS will provide these services through the nearest branches from customers with close and swift collaborations with engineering and construction department in global network.

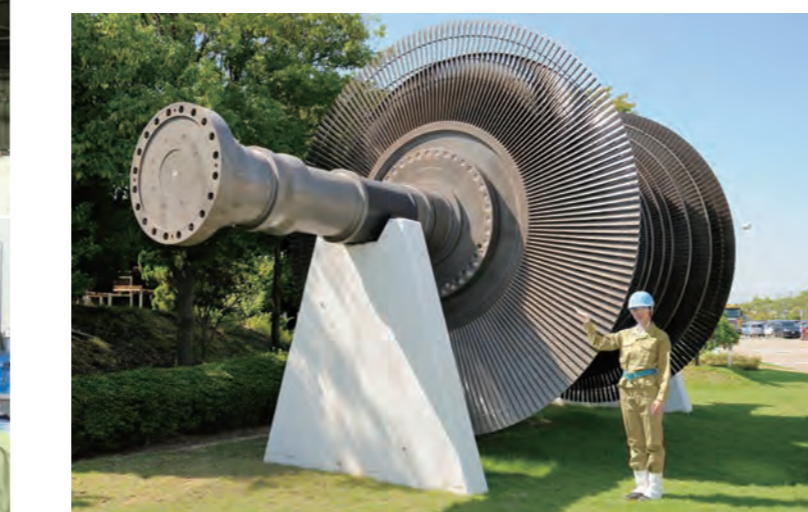
International Certifications

ISO 9001 Certificate (Quality Management System)  
ASME U STAMP  
ISO 14001 Certificate (Environmental Management System)  
ISO/IEC 27001 (Information Security Management System)



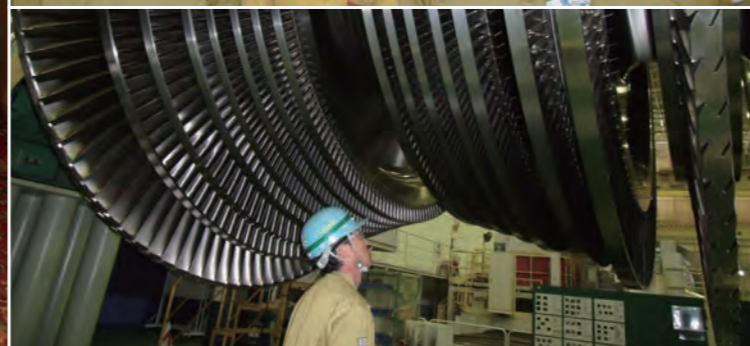
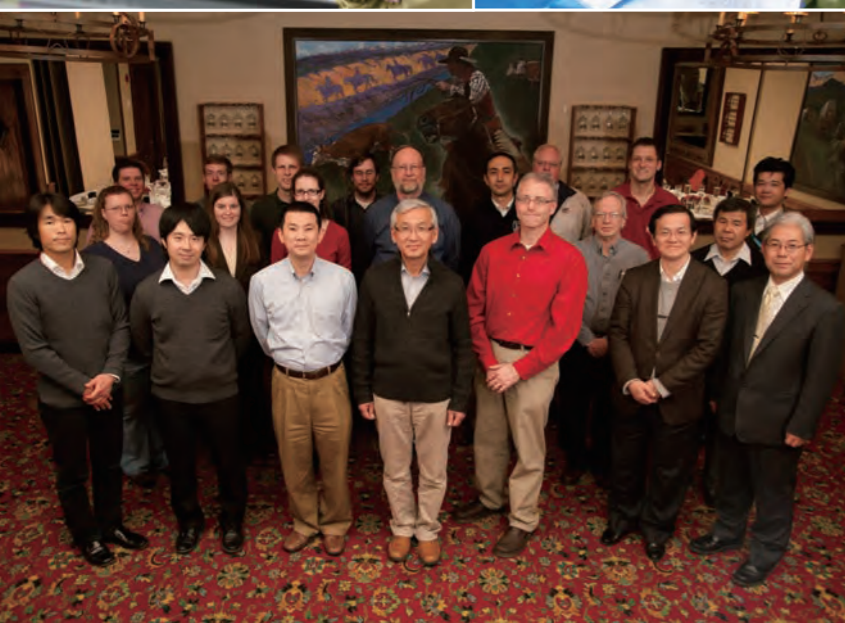
■MHPS provides a Wide Range of Maintenance Services for High Performance & Availability



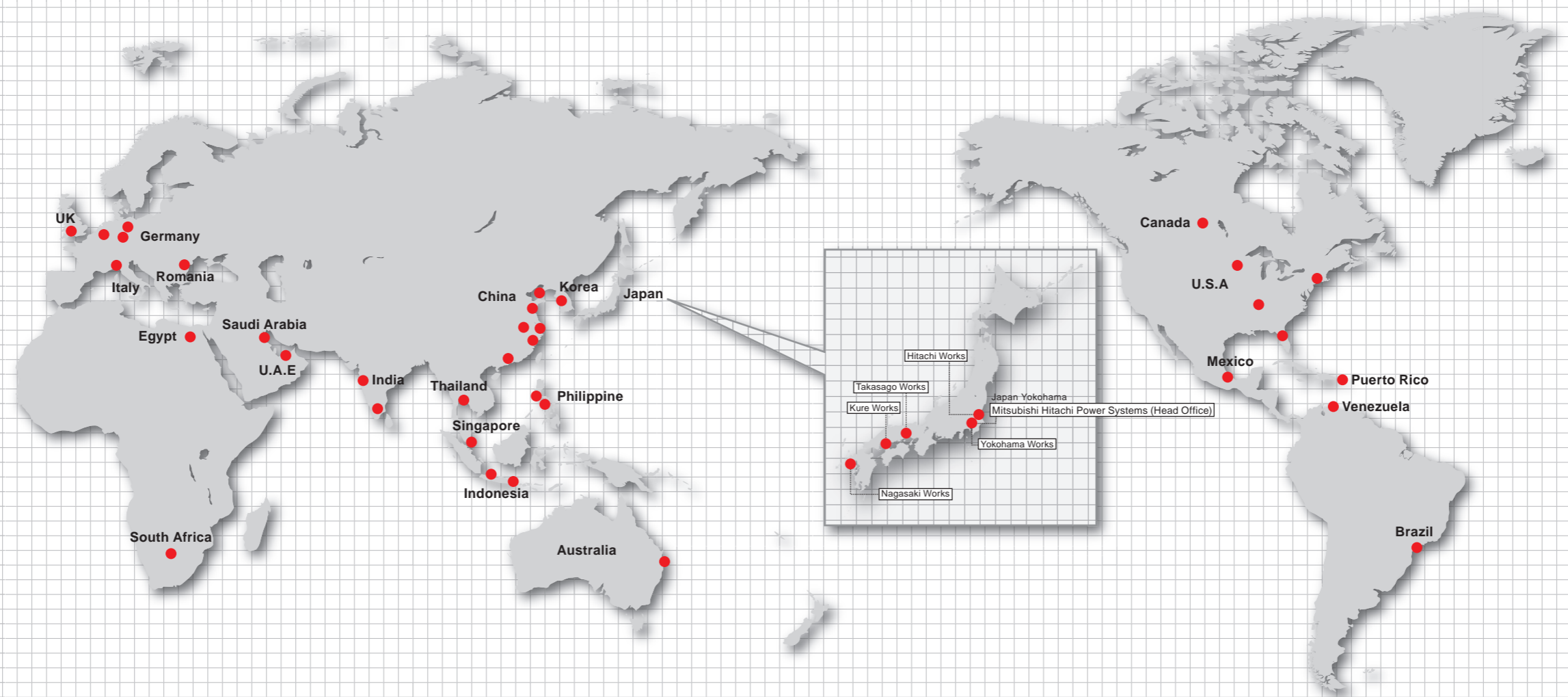


## Epilogue

We hope you are now familiar with MHPS and our nuclear turbine plant. We keep in mind our mission and continue to provide safe and stable electricity through our nuclear turbine plant to customers and people all over the world. If you have any questions about MHPS nuclear turbine plant or any problems at your plants, please inform us freely. We believe we can be of help in one way or another.



# MHPS Global Network



## Europe, Near and Middle East, Africa

- UK**  
Mitsubishi Hitachi Power Systems Europe, Ltd.
- Germany**  
Mitsubishi Hitachi Power Systems Europe GmbH  
Donges Steeltec GmbH  
Meeraner Dampfkesselbau GmbH
- Italy**  
ATLA S.r.l.
- Romania**  
MH Power Systems Romania, S.R.L.
- South Africa**  
Mitsubishi Hitachi Power Systems Africa (Pty) Ltd.
- Egypt**  
MH Power Systems Egypt LLC

- Saudi Arabia**  
MHPS Saudi Arabia Co.
- U.A.E**  
MH Power Systems Middle East, LLC  
MH Power Systems Middle East for Manufacturing Parts and Machinery, LLC
- Asia, Oceania**
- India**  
Mitsubishi Power Systems India Private Limited  
L&T-MHPS Boilers Private Ltd.  
L&T-MHPS Turbine Generators Private Ltd.
- Thailand**  
Mitsubishi Hitachi Power Systems (Thailand) Ltd.  
MHPS Project (Thailand) Co., Ltd.  
EGAT Diamond Service Co., Ltd.
- Singapore**  
Mitsubishi Hitachi Power Systems Asia Pacific Pte. Ltd.

- Philippines**  
MHPS (Philippines) Inc.  
MHPS Technical Services Corporation  
MHPHLS Realty Corporation
- Indonesia**  
P.T. MH Power Systems Indonesia  
P.T. Power Systems Service Indonesia
- Korea**  
MH Power Systems Korea, Ltd.
- Australia**  
Mitsubishi Hitachi Power Systems Australia Pty. Ltd.  
MHPS Plant Service Pty Ltd  
BREAKER ELECTRICAL PTY, LTD.  
Maintenance and Technology Service Pty Ltd

- Japan**  
Mitsubishi Hitachi Power Systems, Ltd.  
Hitachi Works  
Yokohama Works  
Takasago Works  
Kure Works  
Nagasaki Works  
Mitsubishi Hitachi Power Systems Environmental Solutions, Ltd.  
Mitsubishi Hitachi Power Systems Gas Turbine Service Co., Ltd.  
Mitsubishi Hitachi Power Systems Industries Co., Ltd.  
Mitsubishi Hitachi Power Systems Inspection Technologies, Ltd.  
Mitsubishi Hitachi Power Systems Precision Casting Co., Ltd.  
MHPS Engineering Co., Ltd.  
MHPS Control Systems Co., Ltd.
- China**  
Mitsubishi Hitachi Power Systems (China) Co., Ltd.  
Mitsubishi Heavy Industries Dongfang Gas Turbine (Guangzhou) Co., Ltd.\*  
Mitsubishi Hitachi Power Systems Gas Turbine Service (Nanjing) Co., Ltd.  
Mitsubishi Hitachi Power Systems Jieneng (Qingdao) Steam Turbine Co., Ltd.  
Zhejiang Feida MHPS High Efficiency Flue Gas Cleaning Systems Engineering Co., Ltd.  
MHPS (Hangzhou) Environmental Equipment Co., Ltd.  
MHPS Dalian Electricity Equipment Co., Ltd.  
Nanjing Tianling Energy Technology Co., Ltd.  
MHPS Dongfang Boiler Co., Ltd.

## North America, Central America, South America

- Canada**  
Mitsubishi Hitachi Power Systems Canada, Ltd.
- U.S.A**  
Mitsubishi Hitachi Power Systems Americas, Inc.  
Mechanical Dynamics & Analysis, Ltd.  
Mohawk Labor Services, LLC  
Power Generation Services, Inc.  
Turbo Parts, LLC  
Advatech, LLC
- Mexico**  
Mitsubishi Hitachi Power Systems de Mexico, S.A. de C.V.
- Puerto Rico**  
MHPS Puerto Rico, LLC
- Venezuela**  
MH Power Systems de Venezuela, C.A.
- Brazil**  
MH Power Systems America Latina Representacoes Limitada  
CBC Industrias Pesadas S.A.

\*Procedure to change company name currently being undertaken.



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